



The Hong Kong University of Science and Technology

Department of Mathematics

MPhil THESIS EXAMINATION

**Real-Time Tropical Cyclone Pressure and
Wind Field Modelling using Local Measurements from Ground-Level Stations and
Real-Time Tropical Cyclone Reports**

By

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ABSTRACT

Real-time wind speed estimation is central to hazard assessment for tropical cyclones, including for parametric insurance. Current state-of-the-art methods include parametric modeling of TC wind fields, such as the Holland (1980) wind model, and pressure models combined with the gradient balance method. However, existing approaches face several challenges: dependence on sea-surface wind speed measurements or simulations during parameter fitting, oversimplification of wind fields in symmetric models, and uncertainty in physical assumptions. In this thesis, using Hong Kong as a case study, we propose a framework to parametrically model the time series and peak intensity of sea level pressure and wind speed using only SLP measurements and tropical cyclone reports, while systematically comparing the performance of different parametric modeling approaches. The results indicate that our best asymmetric model reproduces TC pressure in Hong Kong with high accuracy ($R > 0.98$ for overall pressure time series and $R > 0.95$ for minimum pressure). Furthermore, the model achieves a high correlation ($R > 0.9$) in capturing peak wind speeds at idealized locations and $R > 0.8$ at other locations, with these results holding even under limited pressure data availability. These findings demonstrate the potential of our models for real-time TC hazard analysis, particularly for parametric insurance applications.

Date : 7 July 2026, Tuesday

Time : 10:00 am

Venue : Room 4472 (Lifts 25-26)

Thesis Examination Committee

Chairman : Prof. Can YANG, MATH /HKUST

Thesis Supervisor : Prof. Jimmy Chi Hung FUNG, MATH/HKUST

Member : Prof. Kai Hon Alexis LAU, ENVR/HKUST

(Open to all faculty and students)

The student's thesis is now being displayed on the reception counter in the General Administration Office (Room 3461).